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Inflight Observations

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The medical monitoring of space crews during flight by ground based Flight Surgeons has been routine since the first Mercury sub-orbital missions. The medical monitoring has been continually evolving throughout this 20 year period. The inflight medical monitoring of the crew of STS-1 built upon the previous years and yet was unique in many respects. The concern about man's ability to withstand the stresses of space flight have diminished in the light of many hours of experience. Therefore, minimum biomedical instrumentation of the crew was used. The monitoring was carried out by recording electro-cardiogram (ECG) during prelaunch, launch, early orbit time, entry, and landing; monitoring crew voice transmission throughout the mission; and conducting a daily private crew medical communication. The personnel performing the inflight monitoring of the crew were Flight Surgeons and Biomedical Engineers (BME). The monitoring took place in the Mission Operations Control Room (MOCR) Figure 3-1, the Medical Staff Support Room (SSR), and in the Mission Control Center (MCC).

There were three Flight Control Teams, one for each major phase of the mission: ascent, orbit, and entry. A MOCR Surgeon and BME were assigned to each of these teams. The MOCR Surgeon provided the medical expertise, and the BME the engineering expertise concerned with medically related systems. The monitoring, conducted by the medical team, included voice and ECG, environmental control systems, food, water, and personal hygiene. The team was basically concerned with any system that had potential direct effects on crew health.

Training of the medical team was conducted through Shuttle systems workbooks, lectures, and integrated simulations. The training period for STS-1 lasted approximately 2 years. The last 6 months were spent in weekly simulation training with the flight control team and the prime or back-up crew in either the motion base or fixed base simulator.

The purpose of the inflight medical monitoring of the crew was to ensure mission success by making certain of the health and safety of the crew. This was, in fact, the basic premise for all phases of the STS-1 mission medical support.

Discussion

STS-1 was to launch at 0700 EST, therefore the crew was to be awakened for preflight procedures at approximately midnight the morning before launch. In order to be in peak mental and physical condition the crews circadian rhythms were adjusted several hours each day during the 5 days before launch, which was scheduled for April 10, 1981. The ascent MOCR Surgeon and BME came on sole at approximately 0130 CST, 4 hours before launch. As soon as the preflight physicals were accomplished by the Crew Surgeon, the excellent health status of the Commander (CDR) and Pilot (PLT) was relayed to the Surgeon in the MOCR. Good quality ECG was received in the MCC soon after the crew ingressed the Orbiter. The ECG and heart rate for the CDR and PLT were felt to be normal and as expected.

During the countdown, Caution and Warning (C&W) alarms were triggered in the Orbiter by a 15.5 psi. cabin pressure. Since this was due to high purge gas temperature and flow rate which would level off soon after launch this was not felt to be a problem. A hold was called shortly after T-20 minutes due to a computer problem with the Back-up Flight System. Attempts at

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fixing the problem were causing prolonged delays. The medical guidelines of a maximum of 6 hours from ingress to launch were quickly approaching. The guidelines were based on the degree of crew comfort while clothed in a full pressure suit and lying in the launch position as well as length of crew work day. The Ascent Surgeon had already made an input to the Flight Director (FD) that if launch did occur, a shortened flight plan for the first day would have to be devised. The launch was scrubbed at 10:00 EST.

The new launch date was set for 0700 EST on April 12, 1981. The crew maintained their early morning wake-up to keep their circadian rhythms in synchronization with the new launch date. Again the preflight physicals were reported to the MOCR Surgeon as normal. After crew ingress of the Orbiter, they reported lack of breathing oxygen with their face plates closed (launch configuration). This was due to an improperly mated quick-disconnect which was fixed by a support crewman. The countdown and launch progressed normally. ECG on both crewmembers was normal prelaunch, during liftoff, and early orbit.

At approximately 35 minutes into the mission the PLT was scheduled (by prior agreement) to take a single prophylactic anti-motion sickness medication, 0.4 mg Scopolamine, 2.5 mg Dexadrine. This was available in a pressure suit pocket. The time of the medication was approximately 30 minutes prior to the PLT egressing his seat and moving to an aft flight deck work station.

The crew was given the go for orbit operations at 3.5 hours Mission Elapsed Time (MET). At this time they both doffed their pressure suits for more comfortable clothing. The crew had continually been ahead of the flight plan and this call was made 20 minutes ahead of schedule.

At about 4 hours into the mission it was noted that cabin temperature had been reading higher than expected, 80°F. However, there were no complaints or comments from the crew and since all systems were functioning the temperature continued to be monitored. The lithium hydroxide cannisters were first installed by the PLT after orbit insertion. The cabin $ppCO_2$ at this point was 5.8 mmHg, well below any Flight Rule limits. This was the highest level seen for the entire mission. A TV look at the crew at approximately 9 hours MET showed them to be doing very well. The evening survey of noise levels in the Orbiter reported them to be low ($\pm$ 65 db) and acceptable for sleeping on the flight deck without earplugs.

The first air-to-ground Private Medical Communication (PMC) was held shortly before the onset of the sleep period. No inflight medical problems, or illnesses were reported. The PLT reported he had no difficulty with motion sickness and had only taken the single pill. He was instructed not to take additional medications and be alert to the development of any motion sickness symptoms.

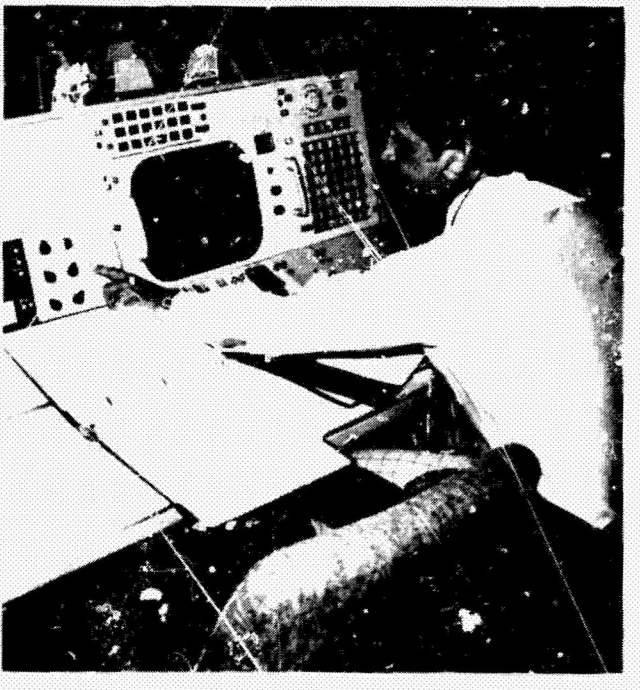

Figure 3-1.- View of the Mission Operation Control Room (MOCR). The STS-1 on duty surgeon in the foreground is Michael A. Berry, M.D.

The first sleep period commenced after a very full 18 hour work day. Cabin temperature at this time was reading 77°F, and the crew reported being cold. It was believed that a temperature transducer was biased high and causing the problem. Prior to sleep the crew set the temperature controller to full warm. They also reset the C&W limit for ppO_2 from 2.8 psi. to 2.7 psi. The medical contingency limit for ppO_2 is 2.6 psi. There was concern that since the normal decay of cabin pressure had not caused any gas flow the 2.8 psi limit might be reached and cause an alarm during sleep.

The sleep period lasted approximately 7 hours and 45 minutes. There had been no alarms during this period. On wake-up the crew reported they had been cold all night and had awakened several times to go below to the mid-deck to get extra clothes for warmth. Both CDR and PLT had slept in their usual seats on the flight deck.

The crew activities for the second flight day were performed as per the normal crew activity plan. The TV news conference with the Vice-President confirmed that they felt they were doing very well.

During the second day environmental problems caused by the Pressure Control System-1 (PCS) and the cabin temperature were resolved by the crew and the MCC. A small leak was detected close to the PCS-1 O_2/N_2 controller value and was causing some false pressure readings. It was felt this situation put no constraint on the usability of the system; therefore PCS-2 was selected with PCS-1 as a fully usable back-up. The cabin temperature was warmed by manipulating water loop flow through the heat exchanger which seemed to solve the problem.

Approximately 3 hours into the second sleep period, the crew was awakened by a Systems Management (SM) alarm. The PLT and CDR were awake for approximately 15 minutes taking care of the situation. There was no other problem during the night and the crew awoke approximately 40 minutes early. Both crewmen reported they had slept very soundly, even with the wake-up, and much better than the previous night. They did not complain of any temperature problems and both sounded in excellent spirits.

The pre-entry activities proceeded normally. ECG was picked up on the PLT first on a stateside pass two revolutions before entry and on the CDR shortly thereafter at Ascension Tracking Station. Normal ECGs were received on the crewmembers.

One additional inflight problem concerned the Waste Control System (WCS). This was not reported until postflight. The WCS commode did not work properly from the beginning, causing urine spillage and odor problems that increased with each use. By entry day it had ceased to function. The crew felt there was not enough suction in the system but, there was not sufficient time to troubleshoot the problem. Postflight evaluation revealed the difficulty was due to a clogged filter which did not allow a full vacuum to be generated.

Concluding Remarks

The crew performed in an excellent manner. No medical problems of any kind were experienced by the crew. No medical treatment inflight was required except for the prophylactic use of an anti-motion sickness medication that had been planned preflight. Several minor system problems occurred affecting crew comfort but had no real mission impact.